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ABSTRACT

This study investigated the effect on word recognition of supplementing a beginning reading program with instruction in distinctive features of alphabet letters. Subjects, 11 first grade students in the experimental sample and 10 first grade students in the control sample in Short Hills, New Jersey, were administered a test of word recognition (20 first grade words from the Harris-Jacobson Core List) as a pre- and posttest. The experimental group received 5 weeks of instruction (15 minutes a day, 5 days a week) in distinctive features of 23 lowercase confusable pairs of letters. Results indicated that instruction in distinctive features of alphabet letters did not improve scores on the word recognition test. (Nine tables of data are included, and 19 references are attached.) (SR)

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DISTINCTIVE FEATURES OF LETTERS

By

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Abstract

The purpose of this study was to determine the effect supplementing a beginning reading program with instruction in distinctive features of alphabet letters would have on a test of word recognition.

The subjects in this study included eleven first grade students in the experimental sample and ten first grade students in the control sample. Each sample was administered a test of word recognition, consisting of twenty first grade words selected from the Harris-Jacobson Core List, as a pretest and as a posttest five weeks later. The experimental sample received instruction in distinctive features of alphabet letters. A total of twenty-three lowercase confusible pairs of letters were presented. Instruction was given to the experimental sample five days a week for five weeks with each session lasting approximately fifteen minutes. Upon conclusion of the five-week period, the test scores for both samples were compared.

The final results indicated that supplementing a first grade reading program with instruction in distinctive features of alphabet letters five times per week for a five-week period did not improve scores on a test of word recognition when compared to a sample not receiving the treatment.

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"In order to identify something as unique, we must know its alternatives - what it might have been, but isn't quite." (Gibson and Levin, 1975)

People, objects and symbols can be grouped into finite sets. Each member of the set shares common features which distinguish that set from other sets. We learn to perceive this and behave adaptively. However, sets can be divided even further. Each member is unique because there are certain differences or feature contrasts within the set. These differences which make the members of a set unique are referred to as distinctive features. Pick (1965) defines distinctive features as "dimensions of difference which distinguish and provide contrasts among objects."

The concept of distinctive features was elaborated by Jacobson and Halle (1956) who applied it to the phonemes in spoken language. Gibson (1963), intrigued by this notion, thought the concept was worth pursuing as it might give educators further insight into understanding children's progression in attaining reading skill. She speculated that children should be taught to visually discriminate between printed letters by looking for their relevant features. Each uppercase and lowercase letter in our Roman alphabet is different from

the other by one or more distinctive feature. For example, the vertical line in the top half of the letter "h" is the distinguishing feature of the letters "n" and "h". The similarity of this pair of letters causes them to be highly confusible to the beginning reader. However, pointing out the distinctive feature that makes the pair different may provide the child with an independent strategy to use when confronted with the letters in context.

Several educators have explored children's literacy learning and have gained much insight about the early stages of reading and writing. Alphabet learning is often an important part of several preschool and kindergarten literacy programs because it is considered to be a reliable predictor of reading success during the first and second grades (Chall, 1967). The majority of children begin school with some knowledge of the alphabet, particulary knowledge of letter names. However, educators assert that children acquire other knowledge in addition to letter name knowledge that is critical to literacy learning. This other knowledge includes an awareness of the features of letters. As children learn letter names they learn to detect letter features (McGee, Richgels, 1989).

Gibson and her colleagues (Gibson, Gibson, Pick, and Osser, 1962) found that four year old children who had not learned to read could detect some letter features. As they increase in chronological and mental age and gain more exposure to letters, children improve in their ability to recognize and differentiate more letter features.

Awareness of letter features also appears to be imperative for children's writing. As they experiment with letter features preschoolers create mock letters which are letterlike symbols made up of letter features (Clay, 1975). Letterlike forms do not appear in children's writing until they are capable of naming and writing a few letters and this experimenting continues into first grade (Sulzby, Barnhart, and Hieshima, 1989).

It appears that it is most helpful for visual discrimination activities to focus on the features of actual letters (Williams, 1969). According to Seaton (1977), children will experience little or no benefit if visual discrimination training involves pictures or geometric shapes. Other researchers contend that even using forms that closely resembled letters did not produce favorable results (Rupley, Ashe, and Buckland, 1979).

Learning about letter features is a natural part of children's literacy experiences. Although children bring to school an awareness of the features of alphabet letters and the interest to explore these features in their writing, few approaches to beginning reading instruction take this into consideration (McGee, Richgels, 1989).

This natural interest has important implications for teachers of preschool, kindergarten, and primary grade children. Perhaps providing beginning readers with instruction that teaches them to recognize and discriminate highly confusible pairs of letters will help them decode words they will inevitably encounter which contain these letters.

HYPOTHESIS

It is hypothesized that children in a beginning reading program supplemented with instruction in feature discrimination of alphabet letters will not be more successful on a test of word recognition when compared to a control group not receiving supplemental instruction in feature discrimination.

DEFINITIONS

Distinctive Features - the distinguishing characteristics of manuscript and cursive letters.

Orientation on the page - left/right reversals such as "b-d" and upside down reversals such as "u-n" are examples of this distinctive feature.

Open - closed - letter pair "c-o" are discriminated by one being a complete circle (closed) and the other an incomplete circle (open).

Line-curve - basic features of writing such as lines or some part of a circle. For example, "C" is distinguished from "D" because the first letter is round and the second letter is part round. The absence of a

curved line distinguishes "E" from "P".

Diagonality - this distinctive feature can be used to distinguish "P" from "R".

Vertical-horizontal - pairs of letters such as "I-L" and "E-F" are examples of this distinctive feature.

PROCEDURE

The subjects used in this study were twenty-one first grade children from Hartshorn School in Short Hills, New Jersey. Each child was randomly placed in one of two samples so that the experimental sample consisted of eleven heterogeneously grouped children and the control sample consisted of ten heterogeneously grouped children.

A test of word recognition was administered to each sample as a pretest in September 1989 and as a posttest five weeks later. This test consisted of twenty first grade words which the examiner selected from the Harris-Jacobson Core List. The words were written with black marker on 3 X 5 inch note cards.

The experimental and control sample each received reading and handwriting instruction as stated in the district's curriculum guide for first grade. In addition, the curriculum for the experimental sample was supplemented with instruction in distinctive features of letters. The children received instruction while seated at a table at the back of the room to provide an informal atmosphere. A total of twenty-three lowercase confusible pairs of letters were presented. Letters were written with black marker on chart paper attached to an easel. For each pair of letters, a three-step teaching procedure was used. First, a letter was presented concurrently with another letter that was highly contrastive, then with one that was less contrastive, and lastly, with a letter that was highly confusible. Only the differences between each pair of letters was discussed. After each lesson, children were given a worksheet to complete independently. They were instructed to find and circle each letter in a row of several confusible letters that was identical to the first letter. The experimental sample met five days a week for five weeks with each session lasting approximately fifteen minutes. During the same time, the control sample met with a student teacher at a table at

the front of the room to receive reinforcement in math skills.

RESULTS

As indicated by the results of the pretest as shown in Tables 1 and II, there was a significant difference between the experimental and control samples' word recognition skill at the onset of the study. The difference between the means (control, 35.5; experimental, 22.3) of 13.2 precluded normal t test analysis. As a result, an analysis of gains of each sample as shown in Tables 1 and 2 was made. In each case, a mean gain

TABLE I

Total Group Pretest and Posttest Results - Mean, Standard Deviation and t-test of the Control Sample on the Test of Word Recognition

Test	M	SD	t
Pretest	35.5	32.00	.93
Post test	48.5	30.28	

18 degrees of freedom - no significance

of 13 points from pre to posttest is shown but these gains were also shown to be not significant for either of the samples.

TABLE II

Total Group Pretest and Posttest Results - Mean, Standard Deviation and t-test of the Experimental Sample on the Test of Word Recognition

Test	M	SD	t
Pretest	22.3	20.90	0.47
Post test	35.45	22.07	

20 degrees of freedom - no significance

An analysis of the mean gain scores of the experimental and control sample as denoted in Table III show no significant difference between the samples.

TABLE III

Total Group Pretest and Posttest Results - Gain Scores of the Control and Experimental Samples on the Test of Word Recognition

Sample	M	SD	t
Control	13.0	7.53	0.06
Experimental	13.18	7.17	

18 degrees of freedom - no significance

A mean gain of 13 points is seen for both samples over the course of instruction.

CONCLUSIONS and IMPLICATIONS

The results of this study allow the conclusion that supplementing the first grade curriculum with instruction in distinctive features of letters five times per week for a five-week period did not improve scores on a Test of Word Recognition when compared to a sample that did not receive the treatment. The hypothesis that no significant difference would result was accepted since

the mean gain in the posttest results were equal for the experimental and control samples.

The implications of this study for educators concerned with beginning reading instruction are that training children to visually discriminate highly confusible pairs of letters on the basis of distinctive features would appear to be not essential for the word recognition aspect of reading. Posttest results revealed only a slight gain in individual and group scores for the experimental sample. A possible explanation for this small increase is that the children in this study had begun the process of learning to read much earlier than the first grade. As a result, they had to deal with the many demands placed on the beginning reader such as grapheme/phoneme correspondence, the process of learning to blend, acquiring a sight vocabulary, and were past the stage of visual discrimination-perception that might benefit from such training. It should be noted that eighteen of the twenty-one children in the sample had no blending ability and little or no sight vocabulary at the onset of the study. Also, in order to work in the time frame allotted for this study, the experiment was undertaken during the first few weeks of the school year, a time when the majority of the

children were adjusting to a full day school program. Since a large number of the children were still functioning at a readiness level when the experiment began, perhaps utilizing a test of letter recognition as a pretest and posttest would have been more appropriate for this particular sample and for future samples at a nursery-pre-kindergarten level.

Future research in this area might consider extending the training period over a greater length of time to determine if such training has any effect on later reading achievement. An additional suggestion is to determine whether a correlation exists between intelligence, the ability to see feature differences, and the transfer of this knowledge to a Test of Word Recognition.

RELATED RESEARCH: DISTINCTIVE FEATURES OF LETTERS

Samuel T. Orton stimulated interest in the reversal type of error associated with serious reading difficulty and attributed it to his neurological theory of lack of cortical dominance (1925). Helen P. Davidson (1934) thought Orton's theory was hardly adequate to explain why some children read letters and words backwards as it would be important to determine at what age cortical dominance is established.

Davidson attributes reversals to a genetic theory of form perception. Her work indicates that young children recognize forms, letters, and words independently of their absolute spatial position. It is natural for young children to read words backwards and eventually perceive words as adults do with an increase in maturity and experience.

Two tests, a Form Perception and a Word Perception Test were used to test her theory as it relates to forms and words. The subjects were 50 kindergarten and 120 first grade students with intelligence ratings of a normal distribution. Results revealed that of the kindergarten population, 93.9% selected one or more reversed forms and 82.6% selected one or more reversed words. Of the first grade population, 61.6% selected one or more reversed forms and 32.8% selected one or

more reversed words. The number of first grade subjects making reversal errors is distinctly less than that of the kindergarten subjects, however, it is still impressively large, especially in the word test. Davidson suggests this may be due to the fact that the first grade children had instruction in reading and knew many of the words. Also the teachers had been encouraged to stress the correct left-to-right eye movements whenever new words were presented.

Tables 4 and 5 of Davidson's study provided data which she used to reveal that the number of children making reversal errors decreased significantly with increasing chronological and mental age. The average number of word reversal errors decreases distinctly at the mental age of five and one-half years. Again at the mental age of six and one-half years and at the chronological age of between six and seven. Also, a distinct decrease in form reversal errors occurs at the mental age of five and one-half years.

TABLE 4

PERCENTAGE OF PUPILS MAKING REVERSAL AND OTHER ERRORS BY CA GROUPS

CA range	N	Form errors Reversals	Form errors Other types	N	Word errors Reversals	Word errors Other types
5-0 to 5- 5	12	83.3	50.0	15	80.0	93.3
5-6 to 5-11	38	83.3	42.1	36	58.3	77.8
6-0 to 6- 5	36	72.2	41.7	37	24.3	62.2
6-6 to 6-11	39	66.6	35.9	41	48.8	70.7
7-0 to 7- 5	16	62.5	31.2	17	41.2	52.9
7-6 to 7-11	8	50.0	12.5	8	12.5	50.0
8-0 to 8-11	7	57.1	14.3	9	44.4	44.4

TABLE 5

PERCENTAGE OF PUPILS MAKING REVERSAL AND OTHER ERRORS BY MA GROUPS

MA range	N	Form errors Reversals	Form errors Other types	N	Word errors Reversals	Word errors Other types
4-0 to 4-11	9	88.9	100.0	8	75.0	100.0
5-0 to 5- 5	13	100.0	61.5	14	85.7	92.8
5-6 to 5-11	24	66.7	50.0	27	62.9	85.2
6-0 to 6- 5	30	76.7	33.3	35	45.7	74.3
6-6 to 6-11	34	70.6	26.5	33	30.3	51.5
7-0 to 7- 5	28	71.4	25.0	28	28.6	42.9
7-6 to 7-11	12	58.3	25.0	12	25.0	83.3
8-0 to 8-11	5	0.0	0.0	5	40.0	40.0
9-0 to 9-11	1	0.0	100.0	1	0.0	0.0

Using the same subjects, Davidson conducted an experiment in order to determine with what letters and to what extent children confuse letters such as "d", "n", "q", and "b". Her primary concern, once more, was with reversals. The Letter Perception Test was administered to 48 kindergarten and 111 first grade children. A letter in large black type was printed at the left side of a sheet of paper. A box containing four rows of ten letters each followed. Five of these letters were identical to the letter at the left, five were of the letter most likely to be confused with it, several each

of other confusing letters, and the remainder of the letters were randomly selected. The children were instructed to mark every letter that was exactly like the given letter.

The results showed that the letter "e" was seldom confused with other letters and the letter "m" was not confused with "n". A greater percentage of kindergarten than first grade subjects made every kind of error which was tested, as is seen in table 2. Although it is not

TABLE 2
PERCENTAGE OF KINDERGARTEN AND FIRST-GRADE PUPILS MAKING EACH TYPE OF ERROR

Grade	d-b	d-p	d-q	n-u	n-h	q-p	q-b	q-d	b-d	b-p	b-q
Kgn.	93.8	50.0	35.4	25.0	35.4	95.8	43.8	27.1	87.5	39.6	41.7
Grade 1	64.9	18.9	13.5	9.9	13.5	62.1	10.8	13.5	60.4	18.9	15.3

consistent, there was a decrease in the percentage of errors with increased chronological age as seen in tables 3 and 4. Interestingly, 50% of the children were

TABLE 3
PERCENTAGE OF PUPILS AT EACH CA LEVEL MAKING EACH TYPE OF ERROR

CA	N	*d-b	d-p	d-q	n-u	n-h	q-p	q-b	q-d	b-d	b-p	b-q
5-0 to 5-5	14	78.6	50.0	28.6	21.4	28.6	85.7	28.6	28.6	78.5	35.7	35.7
5-6 to 5-11	40	85.0	37.5	25.0	20.0	27.5	90.0	37.5	22.5	80.0	30.0	30.0
6-0 to 6-5	34	70.6	20.6	20.6	5.9	5.9	64.7	8.8	8.8	55.9	11.8	20.6
6-6 to 6-11	38	76.3	26.3	23.7	18.4	28.9	68.4	23.7	21.1	71.1	26.3	21.1
7-0 to 7-5	16	62.5	12.5	0.0	6.3	12.5	56.3	0.0	6.3	56.3	37.5	18.8
7-6 to 7-11	8	37.5	25.0	0.0	12.5	12.5	50.0	25.0	12.5	37.5	12.5	0.0
8-0 to 8-5	6	66.7	16.7	16.7	0.0	16.7	66.7	0.0	0.0	83.3	16.7	0.0
8-6 to 8-11	2	50.0	0.0	0.0	50.0	0.0	50.0	0.0	50.0	100.	0.0	50.0
9-0 to 9-5	0	—	—	—	—	—	—	—	—	—	—	—
9-6 to 9-11	0	—	—	—	—	—	—	—	—	—	—	—
10-0 to 10-5	1	100.	100.	100.	0.0	0.0	100.	0.0	100.	100.	100.	100.

*"d-b" means the pupil marked *b* instead of *d*. Similarly "d-p" means *p* was marked instead of *d*; "n-u" means *u* was marked instead of *n*, etc.

TABLE 4

PERCENTAGE OF PUPILS AT EACH CA LEVEL SELECTING *d*, *n*, *q*, AND *b* WITHOUT ERROR

CA	N	d only	n only	q only	b only
5-0 to 5-5	14	14.3	50.0	14.3	14.3
5-6 to 5-11	40	10.0	52.5	10.0	12.5
6-0 to 6-5	34	26.5	76.5	32.3	41.2
6-6 to 6-11	38	21.1	65.8	31.6	26.3
7-0 to 7-5	16	37.5	81.3	43.8	25.0
7-6 to 7-11	8	50.0	75.0	50.0	50.0
8-0 to 8-5	6	16.7	66.7	16.7	16.7
8-6 to 8-11	2	50.0	50.0	50.0	0.0
9-0 to 9-5	0	—	—	—	—
9-6 to 9-11	0	—	—	—	—
10-0 to 10-5	1	0.0	0.0	0.0	0.0

not able to select "d", "q", and "b" without error until a chronological age of seven and one-half years. In contrast, tables 5 and 6 show that an increase in the ability to distinguish between letters of the alphabet corresponds with an increase in mental age. For

TABLE 5

PERCENTAGE OF PUPILS AT EACH MA LEVEL MAKING EACH TYPE OF ERROR

MA	N	d-b	d-p	d-q	n-u	n-h	q-p	q-b	q-d	b-d	b-p	b-q
4-6 to 4-11	8	100.0	62.5	25.0	12.5	37.5	100.0	62.5	50.0	87.5	50.0	50.0
5-0 to 5-5	15	86.7	53.3	40.0	46.7	26.7	86.7	46.7	46.7	93.3	40.0	40.0
5-6 to 5-11	30	86.7	46.7	33.3	23.3	40.0	83.3	26.7	16.7	80.0	33.3	40.0
6-0 to 6-5	34	79.4	23.5	14.7	8.8	11.7	82.4	8.8	11.7	79.4	20.6	14.7
6-6 to 6-11	33	72.7	21.2	18.2	9.1	15.1	69.7	18.2	15.1	60.6	24.2	18.2
7-0 to 7-5	23	56.5	8.7	4.3	8.8	13.0	56.5	17.4	13.0	56.5	17.4	17.4
7-6 to 7-11	11	36.3	9.1	18.2	0.0	9.1	36.4	0.0	0.0	27.3	9.1	0.0
8-0 to 8-5	4	25.0	0.0	0.0	0.0	0.0	25.0	0.0	0.0	25.0	0.0	0.0
8-6 to 8-11	0	—	—	—	—	—	—	—	—	—	—	—
9-0 to 9-5	1	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TABLE 6

PERCENTAGE OF PUPILS AT EACH MA LEVEL SELECTING *d*, *n*, *q*, AND *b* WITHOUT ERROR

MA	N	d only	n only	q only	b only
4-6 to 4-11	8	0.0	37.5	0.0	0.0
5-0 to 5-5	15	0.0	26.7	6.7	0.0
5-6 to 5-11	30	6.7	43.3	16.7	10.0
6-0 to 6-5	34	14.7	70.6	17.6	14.7
6-6 to 6-11	33	25.4	81.8	30.3	36.4
7-0 to 7-5	23	43.5	73.9	39.1	39.1
7-6 to 7-11	11	54.5	90.9	63.6	63.6
8-0 to 8-5	4	75.0	100.0	75.0	75.0
8-6 to 8-11	0	—	—	—	—
9-0 to 9-5	1	0.0	100.0	100.0	100.0

example, confusions between "d-p", "d-q", "n-u", "n-h", "q-b", "q-d", "b-p", and "b-q" are considerably less between the mental age of five and six; but confusions between "d-b", "p-q", and "b-d" are not avoided until the mental age of at least seven and one-half. Davidson notes that this coincides with her earlier study in form and word reversals. Therefore, there is a tendency for beginning readers to confuse certain letters with others, and with some confusions lasting longer than others. The upside down confusion is usually overcome before the left-to-right confusion.

Davidson discusses the following indications to reiterate the theory that young children recognize letters independently of their absolute spatial position:

> There are indications that children pass through certain stages before they are able to distinguish between b and d, p and q. In the first stage, for example, they confuse b with d, p, and q. Apparently the fact that all four letters consist of a circle and a stem is sufficient to establish their identity. In the second stage they confuse b with d but not with p and q. The direction of the stem is apparently a determining factor. In the third stage they consider b and d to be alike although they recognize that these letters face different ways. In the final stage they recognize that b and d are actually different letters.

According to Wendell E. Jeffrey, children who are incapable of discriminating between similar letters can be taught to do so very quickly if the conditions are properly arranged (1958). His conclusion is based on the results of his experiment with four year old children which evaluated the transfer effect from learning a discriminative motor response (button pressing) to the more difficult task of labeling. Jeffrey's rationale for using this particular age group as subjects was based on preliminary research indicating that the majority of four year olds were incapable of labeling stimuli differing in left-right orientation (Swanson and Benton, 1955). His results confirmed that the majority of the four year olds did indeed find the labeling task virtually impossible; however, the experimental treatment of learning to press buttons in the direction the stimuli was pointing was easily

learned and transferred to the task of learning to apply labels.

Eleanor Gibson and her co-workers (1962) studied the development of the ability of children ages four through eight years to visually discriminate a set of letter-like forms. The kinds of errors the children made were related to critical features of letters of the alphabet. Gibson suggests that errors were made involving "perspective transformations", "rotation and reversal transformations" and "line to curve transformations" because they are not distinctive features for object identification in the child's past experience. Few errors were made on "topological transformations" (open-closed as in "c-o"). She indicates that this is because this transformation is a critical feature for object discrimination in the young child's past experiences previous to his experiences in reading. Gibson found that in general, errors decreased with age because children develop a sensitivity to distinctive features as they mature and learn to read.

The results of other studies support the findings of Gibson's study. Helen K. Popp designed a simple matching task for five year old children to determine which pairs of graphemes cause confusion for pre-reading children, and therefore cause difficulty in initial reading instruction (1964). She found that "rotation and reversal transformations" cause more confusion than "topological transformations". Pick (1965) found that "perspective transformations" were impossible for many young children to distinguish. She also tested their ability to discriminate size and discovered that this was just as difficult for young children to deal with.

Let us consider Pick's study in greater detail. A visual discrimination - learning situation and transfer tests were used to test a "distinctive feature" hypothesis. The subjects were sixty kindergarten children randomly assigned to one of three transfer groups. The stimulus forms were letter-like forms similar to those used in Gibson's study. There were six standard forms and six different transformations (involving line-curve, size, reversals, rotations and perspective transformations) of each standard form. Three standard forms were placed on a stand before the subject. Fifteen cards (two copies of each standard form and three transformations of each standard) were spread out on a table before the subject, who was instructed to look at each of them and determine if it was exactly the same or different. This procedure was repeated until a criterion of one perfect trial was reached. The examiner corrected the subject on every trial except the first. The transfer procedure was carried out in the same manner but only one trial was given and no corrections were given. The subjects were divided into three transfer groups. Group C, used as a base line in order to compare the performance of the other two groups, received three standards and three transformations which were different from those used in training. Group E1 received the same standards as in training and three new transformations of these standards. Group E11 received three new standards and the same three types of transformations. The subjects in this group made the fewest confusion errors. Pick suggests that during the training procedure the subjects were improving in their ability to discriminate among the familiar forms. This

carried over to the transfer trial when they were presented with new forms but ones which varied from each other in familiar ways. Figures 1 and 2 show the standards and transformations Pick used in her experiments.

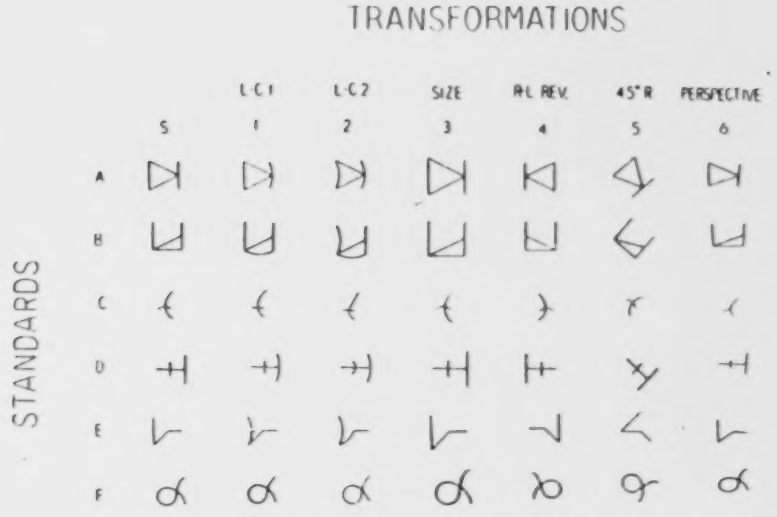

FIG. 1. Standards and transformations used in Exp. I.

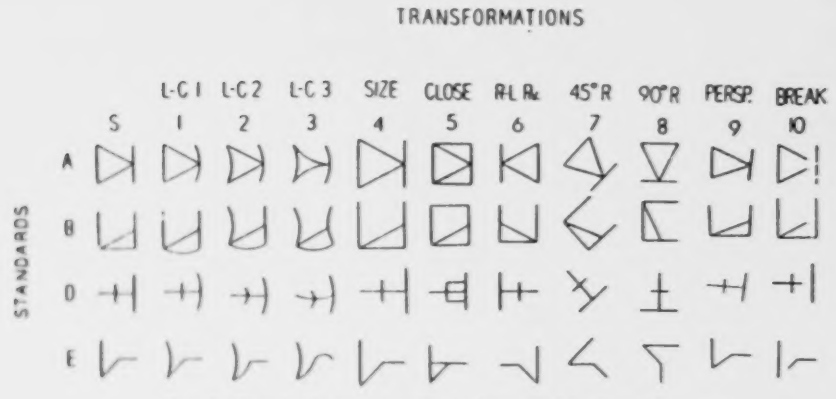

FIG. 2. Standards and transformations used in Exp. II.

According to Maccoby and Bee (1965), more features of a form must be considered in order to reproduce it than to discriminate it from other forms. Although they did not present relevant data to support this statement, they suggest that reproduction training could result in better recognition of forms than could discrimination training because the child is forced to attend to more of the critical features. Joanna P. Williams (1969) elaborates on this theory:

> Furthermore, whether or not reproduction training forces closer attention to the stimuli is likely to depend on the similarity of the standard and the other stimuli from which it must be distinguished. For example, there are few critical features that differentiate between two very similar stimuli. During training, while the subject is attempting to hit upon a feature that is a distinctive one, he will focus on many features, and will be more likely to abstract features that are critical for differentiation of the standard in a different test situation.

Williams compared three conditions in her experiment: discrimination training with the comparison stimuli being quite different from the standard; discrimination training involving comparison stimuli which are transformations (rotations and reversals) of the standards; and reproduction training. Subjects were sixty-four kindergarten children between the ages of four and one-half and five and one-half. Thirty-two children participated in Experiment 1, which was conducted in the first month of kindergarten; the

additional thirty-two children participated in Experiment 2 after they had completed three quarters of the school year. The stimuli were non-symmetrical letter-like forms similar to those designed by Gibson. The four transformations of these standard stimuli were right-left reversal, up-down reversal (mirror image), 180 degree rotation, and 90 degree rotation. Additional stimuli, differing from the standard stimuli but following the same principles, were also used. A comparison of the results of the two experiments showed that the performance of the subjects in Experiment 2 was significantly superior to that of the subjects in Experiment 1. Of the three types of training, no significant difference was found in Experiment 2. In contrast, results of Experiment 1 indicated that discrimination training involving transformations of stimuli was superior to discrimination training involving totally different forms of the stimuli, suggesting that comparisons involving minimally different stimuli forced the children to attend to distinctive features of the standard. In addition, reproduction training was less effective than discrimination involving transformations, however, it was as effective as simple discrimination. Here, focusing on the standards appeared to be equal to simple discrimination, but less than discrimination involving transformations. Therefore, the number of attributes which are attended to in reproduction training as compared to discrimination training seems to coincide with the similarity of forms used in discrimination training. Furthermore, the effectiveness of reproduction training versus discrimination training depends on the level of the

subject. In retrospect, Williams suggests that at the very beginning of kindergarten, more time needs to be devoted to discrimination training involving comparison of letters with their transformations. This should result in less need for later remedial instruction because perceptual confusions will be minimized.

According to Mednick and Lehtinen (1957), young children are known to have a high generalization gradient. This might account for some of the success of these studies and support the concept of distinctive features as being significant.

Researchers have questioned the validity of the studies. Larsen and Hammill (1974) reviewed literature which related visual perceptual abilities to school learning. They contend that I.Q. was inadequately controlled in most of the studies. Rupley, Ashe, and Buckland (1979) also question the literature. They examined whether visual discrimination of individual letters in isolation does indeed transfer to an actual reading task. They suggest that overemphasis on visual discrimination skills can lead to reading problems because the child can be overanalytic in differentiating graphic symbols. They suggest that learning difficulty may be more closely related to cognition and I.Q. than to perceptual abilities. These researchers duplicated Gibson's study and analyzed the data without using I.Q. as a covariate. Results indicated significant relations linking word recognition ability and visual discrimination skills. But when I.Q. variation was controlled, no connection was found.

Controversy exists among researchers as to the effectiveness of simultaneous versus successive methods

of teaching beginning readers to discriminate letters that are highly similar. Two or more stimuli are presented at the same time in simultaneous discrimination; only one stimulus is presented at a time in successive discrimination.

Using first grade children as subjects, Williams and Ackerman (1971) experimented with both methods using the highly similar letters "b" and "d" as stimuli. These letters were selected on the basis of results from Gibson (1962) and Popp (1964) who found that children of this age level often confused "b" and "d". The results revealed that the children learned to discriminate between the letters when they were presented successively. Williams and Ackerman suggest that of the two methods, successive discrimination training is superior because it aids in the identification of critical features since the child attends to only one stimulus at a time. They also assert that children cannot focus as easily on a feature when similar letters are presented simultaneously because too much information is presented at once.

In order to simulate an early reading task, the same researchers conducted an additional and more complex experiment using a different group of first grade children as subjects. The similar letters "b" and "d" were combined into trigrams and presented in a paired - associate task. For example, in order to approximate simultaneous training the stimuli was presented simultaneously in a single trigram ("bad" or "dab"). Likewise, stimuli was presented successively with only one of two letters appearing in a single trigram ("bab" or "dad") to approximate successive

training. Two out of twenty-four children receiving simultaneous training reached criterion; six out of twenty-four children receiving successive training reached criterion. Williams and Ackerman note that this was a difficult task, but these results suggest that successive training is superior.

The purpose of an experiment conducted by Ralls and Fry (1975) was to replicate Williams and Ackerman's experiments using a kindergarten sample with little letter knowledge as subjects. The results indicated that the successive method of presentation leads to more efficient learning in visual discrimination training of like letters, but neither the successive method or the simultaneous method affected the transfer task which involved associating the phoneme for each grapheme in the trigram. However, the researchers stress that this experiment involved large-step transfer which probably expected too much of these young children.

S. Jay Samuels (1973), in his work with kindergarten children, concluded from his results that letters which tend to be confused with one another should first be presented by a simultaneous matching-to-sample task. This will focus attention on the distinctive feature differences of the similar letters. However, the feature differences must be held in memory. To accomplish this, Samuels recommends following simultaneous training with successive matching-to-sample training in order to facilitate visual memory. Samuels and Anderson (1973) stress the importance of visual memory in beginning reading tasks. They experimented and found that second graders who were good readers were superior

in visual recognition memory when compared with their peers who were poor readers.

Henry G. Timko (1983) studied kindergarten children and visual discrimination of confusible letters which are mirror-image reversals. His results revealed that the simultaneous method was superior to the successive method on visual discrimination training, but no significant difference was found between the two methods on the transfer task.

Albert J. Mazurkiewicz (1976) states that research by Pick (1965), Lott (1969), and Gibson (1970) suggests presenting concurrently those letters which are highly confusible with each other. He recommends that the first step in the teaching procedure should be to present a highly contrastive pair of letters such as "d" and "n". Next, present a less contrastive pair such as "d" and "o", and finally a highly confusible pair such as "d" and "b" should be presented. In each case, the focus should be placed on the differences or distinctive features between the letters in each pair and the child should be encouraged to discuss the differences. The final step in this sequence is to locate a certain letter from among a row of several confusible letters. He further recommends locating specific letters in a list of words or in an experience story as a follow-up activity. Mazurkiewicz explains: "Reading requires the ability to discriminate and identify letters in the context of a word, and in such a context the surrounding print on the page may confuse the pupil. This print is essentially distracting "noise" that the pupil must visually "tune out" in order to attend to the features of particular words or letters."

In summary, several alphabet letters, because of their similarity with other alphabet letters, cause confusion for the beginning reader. A decrease in the number of children making these confusions is observed with an increase in chronological and mental age; however, it appears to be evident that highly confusible letters are difficult for children to visually discriminate. Researchers assert that teaching children to look for the distinctive features of these letters will help the decoding process. While many researchers are in agreement as to the importance of teaching distinctive features of letters, the majority of studies designed to determine the effectiveness of simultaneous versus successive methods of teaching feature differences have produced inconsistent results.

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